Space Weather Technical Forecast

Issued on Monday 10 March 2025 at 01:10 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Isolated M-class flares. Spell of Active to G1 Minor Storms, and chance G2 Moderate storm intervals expected day 3-4 (12-13 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with only a few small C-class flares observed, peaking C1.7 at 09/1721 UTC from the near southeast limb. This was likely from the plage area ahead of a new region rotating on the disc. There are seven visible regions on the disc, however these have been mostly fading, including the larger region in the southwest disc, AR4012. The only notable development has been observed in AR4019 in the northeast, with the emergence of a small reverse polarity region near its trailer, and the subsequent development of a weak delta-spot.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: A connection to the fast wind of CH21/- was observed. Solar winds, measured by ACE at L1 rose from elevated at around 500km/s to peak Strong at near 700km/s, before easing back to around 600km/s. Density was near average, at first but declined to below Average. Total Interplanetary Magnetic Field, Bt, was Moderate to Strong at first, at 12-16nT, but eased to be Weak at 5-7nT from 09/1000UTC. The north-south component, Bz, was Moderate at first, varying -14nT to +11nT, but favouring a southward (negative) orientation. This eased to be Weak and more variable from 09/1200 UTC, ranging +7nT to -7nT Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Active to G1 Minor Storm (Kp4-5), with one G2 Moderate Storm interval (09/0300-0600 UTC) until 09/1500 UTC, with Quiet to Unsettled activity then following (Kp2-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background. High energy electron flux (greater than 2 MeV) was varied between Background and Moderate, reaching 422 pfu at 08/1800 UTC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), with 8.77e6 integrated pfu observed at 10/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast, with a chance of Isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no CMEs expected to impact Earth. However, a very slight glancing interaction cannot be ruled out on day 2 (11 Mar) from the passing M1.6-flare CME from 07 Mar, as it misses to the south. Ongoing connection to CH21/- is expected to ease,

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with background or near background winds likely by day 3 (12 Mar). The next fast wind enhancement from CH22/- is then expected late day 3 or day 4 (12-13 Mar). Quiet to Unsettled conditions are expected day 1-3 (10-12 Mar) with a decreasing chance of Active intervals. Any fast wind connection later day 3 or day 4 (12-13 Mar) is expected to bring a further spell of Active to G1 Minor Storms with a chance of G2 Moderate storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at Background. High energy electron flux is likely to reach High later day 1 (10 Mar), and persist at or near this level until the onset of the next coronal hole enhancement late day 3 or day 4 (12-13 Mar). The associated 24 hour fluence is currently below the Active threshold, but is expected to rise with a chance of reaching Active by day 2 (11 Mar).

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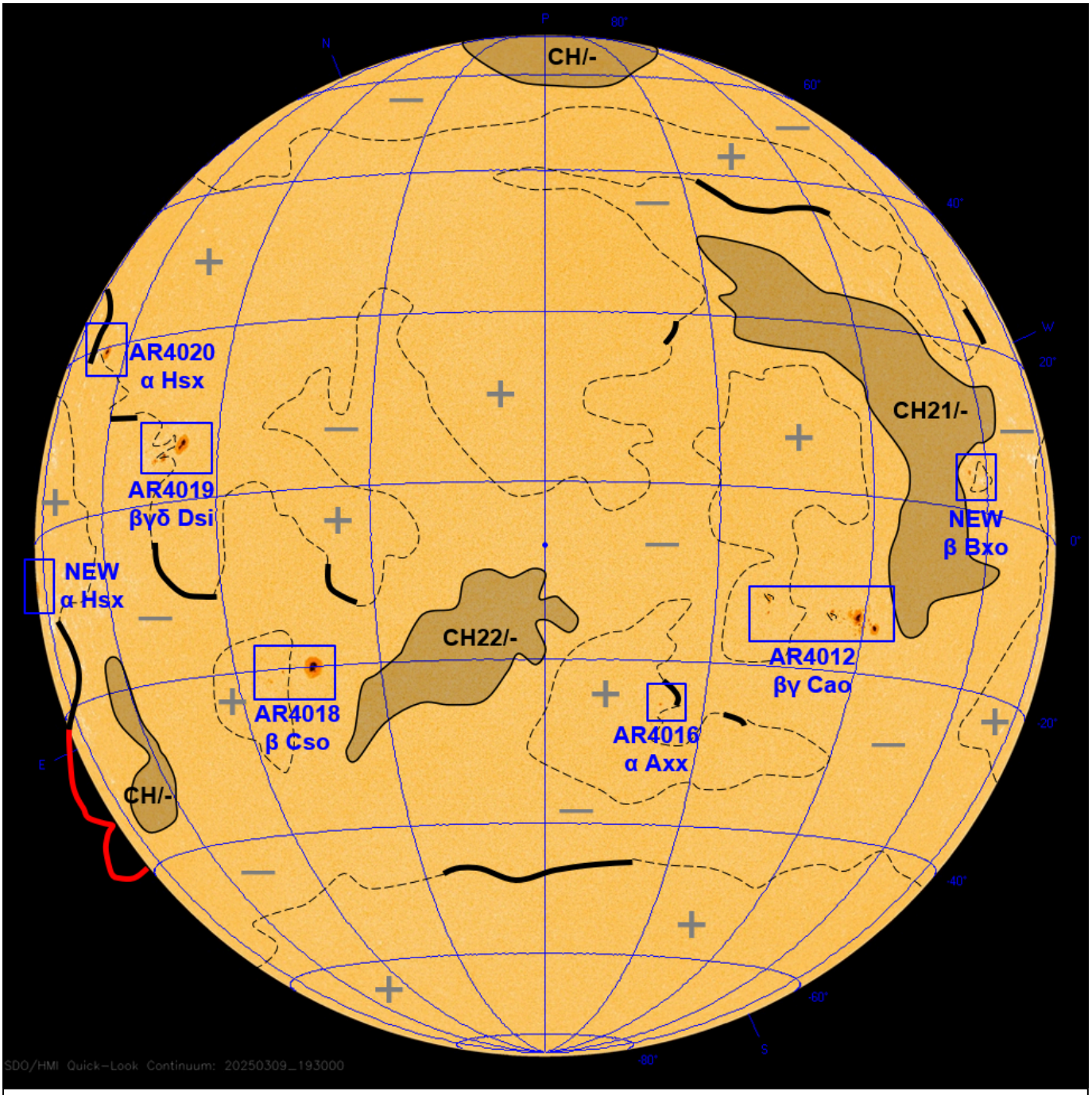
Figure 1: MOSWOC Solar Synoptic Map 09/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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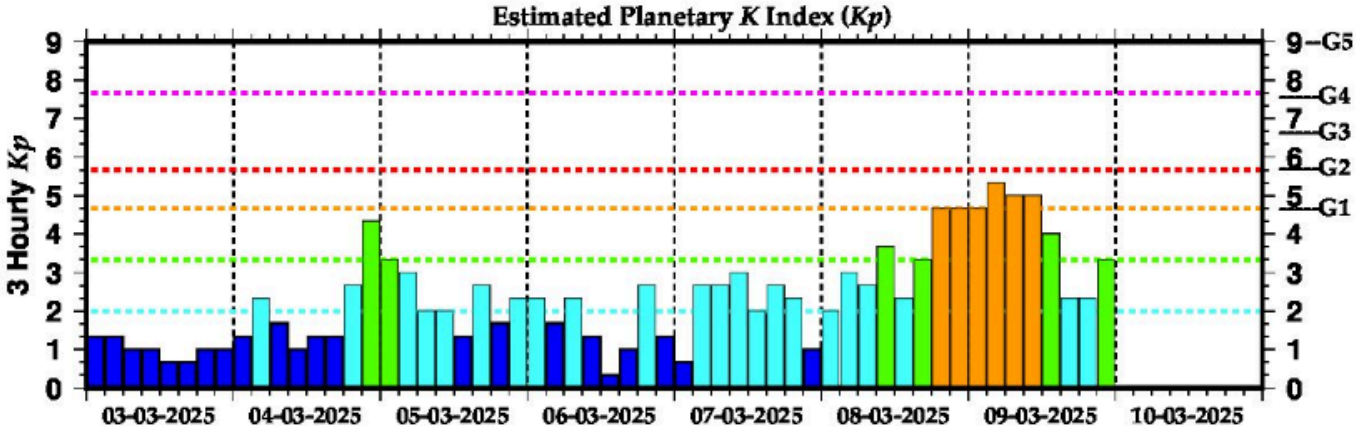
Figure 2: BGS Estimated Planetary K Index



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Geomagnetic Storms

There are no CMEs expected to impact Earth, however the CME from the M1.6-flare around 07/2100 UTC is expected to pass close, to the south, and a weak glance cannot be completely ruled out on day 2 (11 Mar).

Ongoing fast winds from CH21/- at first, are expected to gradually ease through days 1-3 (10-12 Mar), with solar winds easing near, or to, background. Geomagnetic activity is expected to be Quiet to Unsettled through this period, with a decreasing chance of isolated Active intervals.

The next coronal hole enhancement, from CH22, is expected to occur late day 3 or day 4 (12-13 Mar). This is a little earlier than current MOSWOC Enlil expectations which is considered too fast with the expected enhancement. 27-day persistence is not providing good guidance due to this feature being much reduced in its western extent on this rotation. However once this does connect, due to its near equator southern disc location and its negative polarity, which is favoured for connection to Earth at this time of year, Elevated to Strong solar winds are likely along with a spell of Active to G1 Minor Storms with isolated G2 Moderate storm intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	5	5	30	70
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
08/0050	Partial	AR4016	34S 06E	825	Missing	Small chance of weak, glancing arrival on 11 Mar

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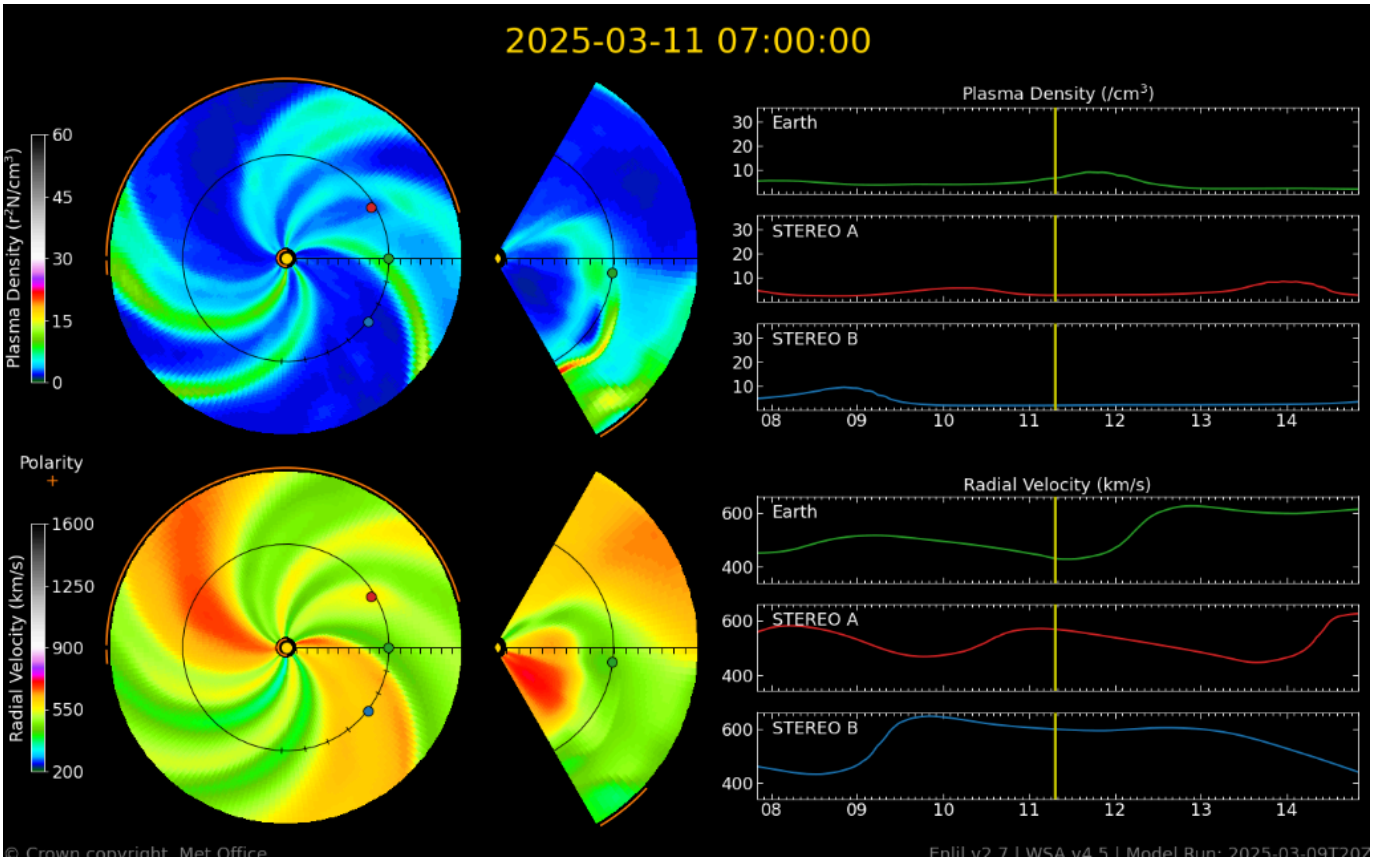
Figure 3: L1 (ACE) Solar winds showing the HSS enhancement

Figure 4: MOSWOC Enlil showing CME passing south of Earth, but also onset of the next fast wind enhancement. This is considered too early in Enlil, likely occurring later 12 or 13 Mar.



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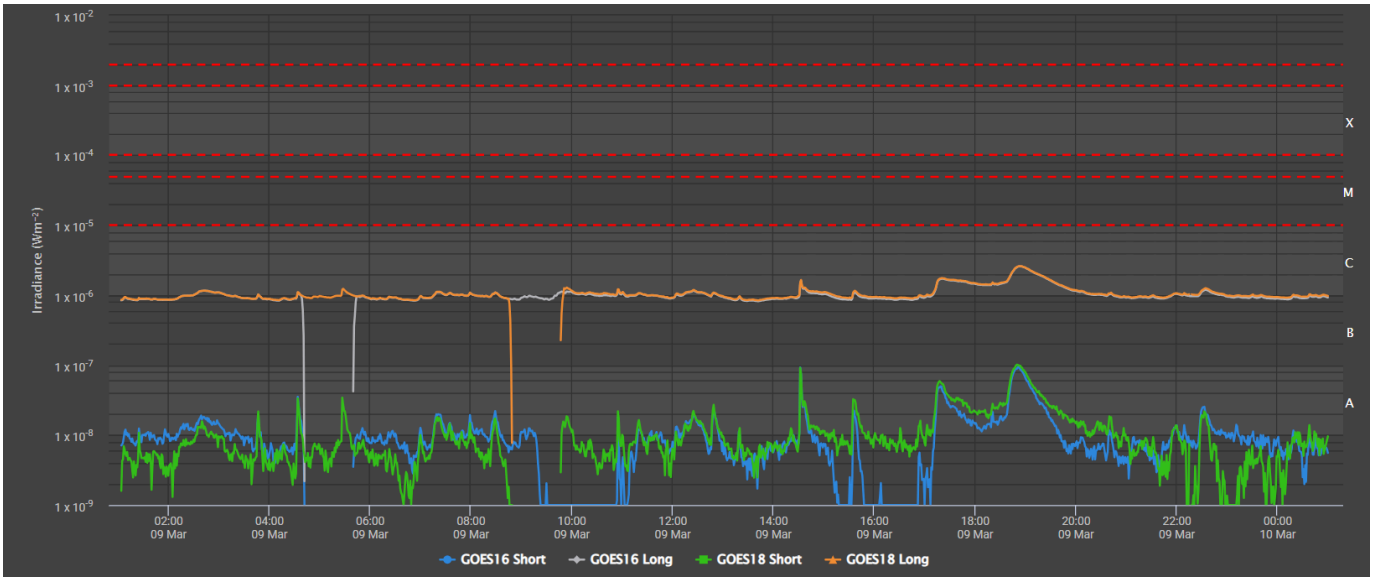
Radio Blackouts - X-Ray Flares

Solar activity is generally Low with only a few low C-class flares observed. While there are seven regions on the Earth-facing disc, these are generally small and simple, with most of these showing decline. This includes the longitudinally wide AR4012 in the southwest, which has seen its trailer largely decay and lose penumbra, along with the loss of a number of its intermediate spots. Although the leader persists as a fragmented collection of small spots, and there is some mixing of polarities in both the leader and trailer maintains a small amount of complexity. Despite this, the overall trend for this region is a declining one.

Perhaps the most notable region is AR4019 in the northeast, which over the last 24 hours has seen the emergence of a very small negative polarity spot near its positive trailer, along with the growth of some weak penumbra which has resulted in the development of a small delta-configuration. Further growth could increase the flare potential from this region. Also of interest is the new region on the southeast limb. This is possibly associated with recent C-flaring near this location, although this was perhaps from the plage are just ahead of it. While this region is too close to the limb for a complete analysis, there is some magnetic looping evident above the spot on SDO imagery, suggesting the potential for further complexity to become apparent as this moves to a less oblique viewing angle.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 5: GOES 16/18 X-ray Irradiance showing limited activity.



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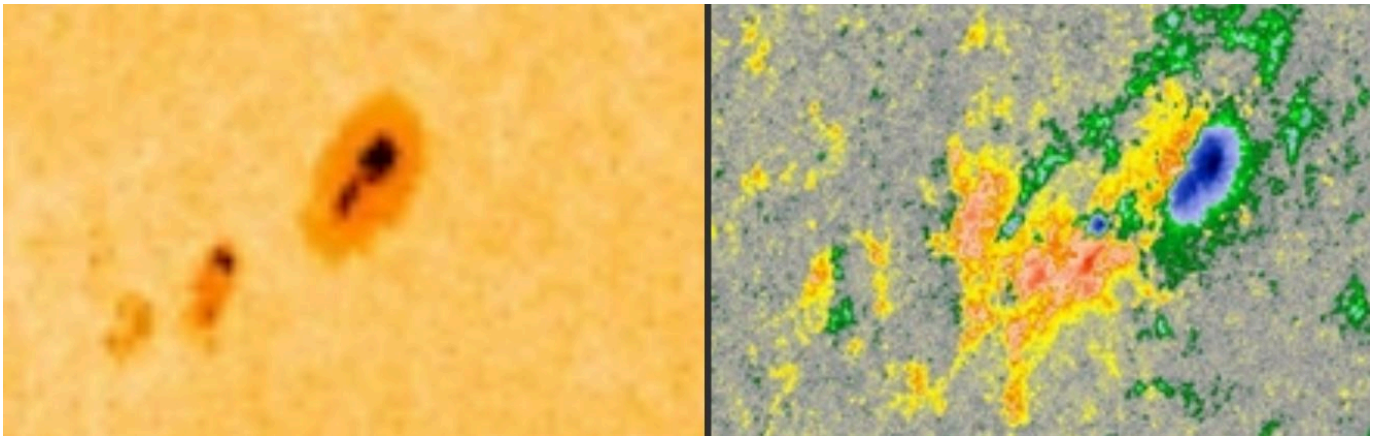
Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to persist at Background, with the current regions on the disc unlikely to produce events that would give a notable enhancement.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	2	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 6: AR4019 showing weak delta-configuration in main trailer region.



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High Energy Electrons (≥ 2MeV)

The high-energy electron flux (>2MeV) as observed at GOES16 is expected to show a rising trend as solar winds ease from the recent fast wind connection. This will lead to mainly Moderate flux, and an increasing chance of persistent High flux from later from day 1 (10 Mar). Confidence is low for the longevity of this high flux however due to the potential fast wind onset from CH22/- later on day 3 and into day 4 (12-13 Mar), along with the very slight chance of a CME glance on day 2 (11 Mar), providing the potential for drop out of the observed flux at GEO.

The associated fluence 24 hour is subsequently expected to rise through days 1-2 (10-11 Mar), before seeing either a levelling trend, or perhaps declining thereafter. Both 27-day recurrence and the MOSWOC REFM are currently giving good guidance for the rising trend, although this is likely underestimating the peak fluence, which is likely to rise above the Active threshold later day 2 (12 Mar).

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	40	40	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 7: GOES 16 >2MeV electron flux and REFM

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